

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Canceled).

Claim 2 (Previously Presented): A color space converting apparatus for converting a color value of a first color space to a color value of a second color space, said color space converting apparatus comprising:

a first color space converting module for converting the color value of the first color space to the color value of the second color space so as to eliminate deviation of a converted color value derived by converting the color value of a white point of the first color space to the second color space, and the color value of a white point of the second color space, wherein the first color space converting module includes

a plurality of color conversion tables, prepared for each combination of the first color space and second color space, having characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space;

a selecting module for selecting, on the basis of a combination of the first color space and the second color space, one color conversion table from among the plurality of color conversion tables; and

a second color space converting module for converting a color value of the first color space to a color value of the second color space using the selected color conversion table.

Claim 3 (Previously Presented): A color space converting apparatus for converting a color value of a first color space to a color value of a second color space, said color space converting apparatus comprising:

a first color space converting module for converting the color value of the first color space to the color value of the second color space so as to eliminate deviation of a converted color value derived by converting a color value of a white point of the first color space to the second color space, and a color value of a white point of the second color space, wherein the first color space converting module includes

a plurality of color conversion matrices, prepared for each combination of the first color space and second color space, having characteristics for matching a converted color

value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space;

a selecting module for selecting, on the basis of a combination of the first color space and the second color space, one color conversion matrix from among the plurality of color conversion matrices; and

a second color space converting module for executing a matrix operation to convert a color value of the first color space to a color value of the second color space using the selected color conversion matrix.

Claim 4 (Previously Presented): A color space converting apparatus according to claims 2 or 3 wherein the first color space and second color space are device-dependent color spaces dependent on a device, and

a first color value of a device-independent color space, derived by converting the color value of the white point of the first color space, is equal to a second color value of the device-independent color space, derived by converting the color value of the white point of the second color space.

Claims 5 and 6 (Canceled).

Claim 7 (Previously Presented): A color space converting apparatus for matching a color value of a white point of a first color space with a color value of a white point of a second color space in a device-independent color space that is independent of any device, and converting a color value of the first color space to a color value of the second color space, said color space converting apparatus comprising:

a plurality of color conversion tables, prepared for each combination of the first color space and second color space, having characteristics for matching the color value of the white point of the second color space with a converted color value, derived by converting the color value of the white point of the first color space to the second color space using a third matrix generated on the basis of a first matrix for converting a color value of the first color space to a color value of the device-independent color space, and a second matrix for converting a color value of the second color space to a color value of the device-independent color space;

a selecting module or selecting, on the basis of a combination of the first color space and the second color space, one color conversion table from among the plurality of color conversion tables; and

a color space converting module for converting a color value of the first color space to a color value of the second color space using the selected color conversion table.

Claim 8 (Previously Presented): A color space converting apparatus for matching a color value of a white point of a first color space with a color value of a white point of a second color space in a device-independent color space that is independent of any device, and converting a color value of the first color space to a color value of the second color space, said color space converting apparatus comprising:

a color space converting module for converting a color value of the first color space to a color value of the second color space using a third matrix created on the basis of a first matrix for converting a color value of the first color space to a color value of the device-independent color space and a second matrix for converting a color value of the second color space to a color value of the device-independent color space;

a deviation calculating module for calculating deviation of the color value of an achromatic color of the second color space with respect to a converted color value converted from the color value of an achromatic color of the first color space to a color value of the second color space by means of the converting module; and

a conversion accuracy improving module for reflecting the calculated deviation to improve color space conversion accuracy by the color space converting module.

Claim 9 (Previously Presented): A color space converting apparatus according to claim 8 wherein the conversion accuracy improving module reflects the deviation and corrects the color value converted to a color value of the second color space.

Claim 10 (Previously Presented): A color space converting apparatus according to claim 8 wherein the conversion accuracy improving module reflects the deviation and corrects the third matrix to improve the conversion accuracy.

Claim 11 (Previously Presented): A color space converting apparatus for matching a color value of a white point of a first color space with a color value of a white point of a second color space in a device-independent color space that is independent of any device, and converting a color value of the first color space to a color value of the second color space, said color space converting apparatus comprising:

 a plurality of color conversion matrices, prepared for each combination of the first color space and second color space, having characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space;

 a selecting module for selecting, on the basis of a combination of the first color space and the second color space, one color conversion matrix from among the plurality of color conversion matrices; and

 a color space converting module for executing a matrix operation, using the selected color conversion matrix, to convert a color value of the first color space to a color value of the second color space.

Claim 12 (Previously Presented): A color space converting apparatus according to any of claims 7 to 11 further comprising:

 a file reader for reading the color value and output control information from a file that includes within a single file the color value and the output control information, which stipulates output conditions for color values;

 wherein the first color space is determined on the basis of the read output control information.

Claim 13 (Previously Presented): A color space converting apparatus for converting a color value of a first color space to a color value of a second color space, said color space converting apparatus comprising:

- a first converting module for converting a color value of the first color space to a color value of a device-independent color space using a first matrix;

- a second converting module for converting a color value of the second color space to a color value of the device-independent color space using a second matrix;

- a determining module for determining whether a color value of a first white point in the device-independent color space, converted from the color value of the white point of the first color space by the first converting module, matches ~~the~~ a color value of a second white point in the device-independent color space, converted from the color value of the white point of the second color space by the second converting module;

- a third converting module for converting a color value of the first color space to a color value of the second color space using a third matrix created on the basis of the first matrix and the second matrix;

- a deviation calculating module that, in the event it is determined that the color value of the first white point and the color value of the second white point match, calculates deviation of a color value of an achromatic color of the second color space and a converted color value that has been converted by the third converting module from a color value of an achromatic color of the first color space to a color value of the second color space; and

- a conversion accuracy improving module for improving color space conversion accuracy by the third converting module on the basis of the calculated deviation.

Claim 14 (Previously Presented): A color space converting apparatus according to claim 13 further comprising:

- a first correcting module that, in the event it is determined that the color value of the first white point and the color value of the second white point do not match, corrects the second matrix so that the color value of the second white point matches the color value of the first white point.

Claim 15 (Previously Presented): A color space converting apparatus according to claim 13 further comprising:

a second correcting module that, in the event it is determined that the color value of the first white point and the color value of the second white point do not match, corrects the first matrix so that the color value of the first white point matches the color value of the second white point.

Claim 16 (Previously Presented): A color space converting apparatus for matching a white point in a first RGB color space with a white point in a second RGB color space in an XYZ color space, and converting a color value (R1, G1, B1) in the first RGB color space to a color value (R2, G2, B2) in the second RGB color space, wherein said color space converting apparatus comprises:

a converting module for converting a color value (R1, G1, B1) of the first RGB color space to a color value (R2, G2, B2) of the second RGB color space by means of the following Equation 1, using a matrix $L=N^1M$ calculated in advance on the basis of a matrix M used for converting a color value in a first RGB color space to a color value of an XYZ color space, and a matrix N used for converting a color value in a second RGB color space to a color value of an XYZ color space;

$$\begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = L \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a3 & b3 & c3 \\ d3 & e3 & f3 \\ g3 & h3 & i3 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 1}$$

a deviation calculating module for calculating deviation of a color value (1, 1, 1) representing the white point of the second color space with respect to a converted white point color value (a3 + b3 + c3, d3 + e3 + f3, g3 + h3 + i3), converted by the converting module from a color value (1, 1, 1) representing the white point of the first color space, to a color value representing the white point of the second color space; and

a conversion accuracy improving module for reflecting the calculated deviation to improve color space conversion accuracy by the converting module.

Claim 17 (Previously Presented): A color space converting apparatus for converting a color value (R1, G1, B1) in a first RGB color space to a color value (R2, G2, B2) in a second RGB color space, wherein said color space converting apparatus comprises:

a first converting module for converting a color value (R1, G1, B1) of the first RGB color space to a color value (X, Y, Z) of an XYZ color space by means of the following Equation 1, using a matrix M;

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = M \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a1 & b1 & c1 \\ d1 & e1 & f1 \\ g1 & h1 & i1 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 1}$$

a second converting module for converting a color value (R2, G2, B2) of the second RGB color space to a color value (X, Y, Z) of an XYZ color space by means of the following Equation 2, using a matrix N;

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = N \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = \begin{pmatrix} a2 & b2 & c2 \\ d2 & e2 & f2 \\ g2 & h2 & i2 \end{pmatrix} \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} \quad \text{Equation 2}$$

a third converting module for converting a color value (R1, G1, B1) of the first RGB color space to a color value (R2, G2, B2) of the second RGB color space by means of the following Equation 3, using a matrix $L=N^{-1}M$ calculated in advance on the basis of a matrix M and matrix N;

$$\begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = L \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a3 & b3 & c3 \\ d3 & e3 & f3 \\ g3 & h3 & i3 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 3}$$

a determining module for determining whether the three relationships $a1 + b1 + c1 = a2 + b2 + c2$, $d1 + e1 + f1 = d2 + e2 + f2$, and $g1 + h1 + i1 = g2 + h2 + i2$ are true for a color value of the XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the first RGB color space by means of the first converting module, and a color value of the XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the second RGB color space by means of the second converting module;

a deviation calculating module that, in the event it is determined that the three relationships are true, calculates deviation of a color value (1, 1, 1) representing the white point of the second RGB color space with respect to a converted color value ($a3 + b3 + c3$, $d3 + e3 + f3$, $g3 + h3 + i3$), converted by the third converting module from a color value (1, 1, 1)

representing the white point of the first RGB color space to a color value of the second RGB color space; and

a first correcting module for correcting the coefficients of the matrix L so as to eliminate the calculated deviation.

Claim 18 (Previously Presented): A color space converting apparatus according to claim 17 further comprising:

a second correcting module that, in the event that it is determined that at least one relationship of the three relationships is not true, corrects the matrix N.

Claim 19 (Previously Presented): A color space converting apparatus according to claim 17 further comprising:

a third correcting module that, in the event that it is determined that at least one relationship of the three relationships is not true, corrects the matrix M.

Claim 20 (Canceled).

Claim 21 (Previously Presented): A method of color space conversion for converting a color value of a first color space to a color value of a second color space, said method of color space conversion comprising:

determining whether a color value of a first white point converted from a color value of a white point of the first color space to a color value of a device-independent color space using a first matrix, matches the color value of a second white point converted from a color value of a white point of the second color space to a color value of the device-independent color space using a second matrix;

when it is determined that the color value of the first white point and the color value of the second white point match, calculating deviation of the color value of the second white point with respect to a converted value converted to the second color space from the color value of an achromatic color of the first color space using a third matrix created on the basis of the first matrix and the second matrix; and

correcting the matrix coefficients of the third matrix so as to eliminate the calculated deviation.

Claim 22 (Previously Presented): A method of color space conversion for converting a color value (R1, G1, B1) in a first RGB color space to a color value (R2, G2, B2) in a second RGB color space, said method of color space conversion comprising:

determining whether the three relationships $a1 + b1 + c1 = a2 + b2 + c2$, $d1 + e1 + f1 = d2 + e2 + f2$, and $g1 + h1 + i1 = g2 + h2 + i2$ are true for a color value of an XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the first color space using the following Equation 1 including a matrix M, and a color value of the XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the second RGB color space using the following Equation 2 including a matrix N;

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = M \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a1 & b1 & c1 \\ d1 & e1 & f1 \\ g1 & h1 & i1 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 1}$$

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = N \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = \begin{pmatrix} a2 & b2 & c2 \\ d2 & e2 & f2 \\ g2 & h2 & i2 \end{pmatrix} \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} \quad \text{Equation 2}$$

in the event it is determined that the three relationships are true, calculating deviation of a color value (1, 1, 1) representing the white point of the second color space with respect to a converted color value ($a3 + b3 + c3$, $d3 + e3 + f3$, $g3 + h3 + i3$), converted from a color value (1, 1, 1) representing the white point of the first color space to a color value of the second color space using the following Equation 3 including a matrix N precalculated on the basis of matrix M and matrix N; and

$$\begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = L \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a3 & b3 & c3 \\ d3 & e3 & f3 \\ g3 & h3 & i3 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 3}$$

correcting the coefficients of the matrix L so as to eliminate the calculated deviation.

Claims 23 and 24 (Canceled).

Claim 25 (Previously Presented): A color space converting program for converting a color value of a first color space to a color value of a second color space, wherein said color space converting program is embodied on a computer-readable medium and includes program instructions for causing a computer to implement:

a function for determining whether a color value of a first white point converted to a device-independent color space from a color value of a white point of the first color space using a first matrix matches a color value of a second white point converted to a device-independent color space from a color value of a white point of the second color space using a second matrix;

a function that, in the event that it is determined that the color value of the first white point and the color value of the second white point match, calculates deviation of a color value of an achromatic color of the second color space with respect to a converted value converted to the second color space from the color value of an achromatic color of the first color space using a third matrix created on the basis of the first matrix and the second matrix; and

a function for reflecting the calculated deviation to improve the accuracy of the color conversion.

Claim 26 (Previously Presented): A color space converting program for converting a color value (R1, G1, B1) in a first RGB color space to a color value (R2, G2, B2) in a second RGB color space, wherein said color space converting program is embodied on a computer-readable medium and includes program instructions for causing a computer to implement:

a function for determining whether the three relationships $a1 + b1 + c1 = a2 + b2 + c2$, $d1 + e1 + f1 = d2 + e2 + f2$, and $g1 + h1 + i1 = g2 + h2 + i2$ are true for a color value of a XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the first color space using the following Equation 1 including a matrix M, and a color value of the XYZ color space derived by converting a color value (1, 1, 1) representing a white point of the second color space using the following Equation 2 including a matrix N;

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = M \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a1 & b1 & c1 \\ d1 & e1 & f1 \\ g1 & h1 & i1 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 1}$$

$$\begin{pmatrix} X \\ Y \\ Z \end{pmatrix} = N \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = \begin{pmatrix} a2 & b2 & c2 \\ d2 & e2 & f2 \\ g2 & h2 & i2 \end{pmatrix} \begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} \quad \text{Equation 2}$$

a function that, in the event it is determined that the three relationships are true, calculates deviation of a color value (1, 1, 1) representing the white point of the second color space with respect to a converted color value ($a3 + b3 + c3$, $d3 + e3 + f3$, $g3 + h3 + i3$), converted from a color value (1, 1, 1) representing the white point of the first color space to a color value of the second color space using the following Equation 3 including a matrix N precalculated on the basis of matrix M and matrix N; and

$$\begin{pmatrix} R2 \\ G2 \\ B2 \end{pmatrix} = L \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} = \begin{pmatrix} a3 & b3 & c3 \\ d3 & e3 & f3 \\ g3 & h3 & i3 \end{pmatrix} \begin{pmatrix} R1 \\ G1 \\ B1 \end{pmatrix} \quad \text{Equation 3}$$

a function for reflecting the calculated deviation to improve the accuracy of the color conversion.

Claims 27-30 (Canceled).

Claim 31 (Previously Presented): A method of color space conversion for converting a color value of a first color space to a color value of a second color space, said method of color space conversion comprising:

converting a color value of the first color space to a color value of the second color space so as to eliminate deviation of the color value of a white point of the second color space from a converted color value converted to the second color space from the color value of a white point of the first color space, wherein the converting a color value of the first color space to a color value of the second color space includes

selecting, on the basis of a combination of the first color space and the second color space, one color conversion table from among a plurality of color conversion tables, wherein the plurality of color conversion tables, prepared for each combination of the first color space and second color space, has characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space; and

converting a color value of the first color space to a color value of the second color space using the selected color conversion table.

Claim 32 (Previously Presented): A method of color space conversion for converting a color value of a first color space to a color value of a second color space, said method of color space conversion comprising:

converting a color value of the first color space to a color value of the second color space so as to eliminate deviation of the color value of a white point of the second color space from a converted color value converted to the second color space from the color value of a white point of the first color space, wherein the converting a color value of the first color space to a color value of the second color space includes

selecting, on the basis of a combination of the first color space and the second color space, one color conversion matrix from among a plurality of color conversion matrices, wherein the plurality of color conversion matrices, prepared for each combination of the first color space and second color space, has characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space; and

executing a matrix operation to convert a color value of the first color space to a color value of the second color space using the selected color conversion matrix.

Claim 33 (Previously Presented): A color space converting program for converting a color value of a first color space to a color value of a second color space, wherein said color space converting program is embodied on a computer-readable medium and includes program instructions for causing a computer to implement:

a first color conversion function for converting a color value of the first color space to a color value of the second color space, in such a way as to eliminate deviation of a converted color value, derived by converting a color value of a white point of the first color space to the second color space, with respect to the color value of a white point of the second color space, wherein the first color conversion function includes

a selecting function for selecting, on the basis of a combination of the first color space and the second color space, one color conversion table from among a plurality of color conversion tables, wherein the plurality of color conversion tables, prepared for each combination of the first color space and second color space, has characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space; and

a second color conversion function for converting a color value of the first color space to a color value of the second color space using the selected color conversion table.

Claim 34 (Previously Presented): A color space converting program for converting a color value of a first color space to a color value of a second color space, wherein said color space converting program is embodied on a computer-readable medium and includes program instructions for causing a computer to implement:

a first color conversion function for converting a color value of the first color space to a color value of the second color space, in such a way as to eliminate deviation of a converted color value, derived by converting a color value of a white point of the first color space to the second color space, with respect to the color value of a white point of the second color space, wherein the first color conversion function includes

a selecting function for selecting, on the basis of a combination of the first color space and the second color space, one color conversion matrix from among a plurality of color conversion matrices, wherein the plurality of color conversion matrices, prepared for each combination of the first color space and second color space, has characteristics for matching a converted color value, derived by converting to the second color space the color value of the white point of the first color space, with the color value of the white point of the second color space; and

a second color conversion function for executing a matrix operation to convert a color value of the first color space to a color value of the second color space using the selected color conversion matrix.

Claims 35 and 36 (Canceled).